

Sports Hall, Leighton Park School, Reading RG2 7ED

Energy Strategy Report

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Job Number: 27392

Date	Version	Notes/Amendments/Issue Purpose
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Acronyms	
ASHP	Air Source Heat Pumps
BRE	Building Research Establishment
CHP	Combined Heat and Power
GSHP	Ground Source Heat Pumps
LZC	Low and zero carbon
PV	Photovoltaic
SAP	Standard Assessment Procedure

Executive Summary

This report details the energy strategy for the proposed Sports Hall of Leighton Park School in Reading. The scheme will provide a large sports hall, fitness suite and associated changing facilities. Reading Borough Council requires all new developments to maximise the use of energy efficiency and conservation measures to reduce the overall energy demand and offset carbon emissions by at least 20% through on-site renewables.

The proposed development addresses national and local planning policies on energy; in particular, mitigation of climate change and energy security through energy efficiency enhancements and use of alternative energy technologies. In order to reduce the carbon footprint of the building beyond the requirements of current regulatory and market standards, the development will benefit from the following integrated systems:

- Passive design features (Be Lean);
- Energy efficiency measures (Be Clean); and
- Low and zero carbon technologies (Be Green).

The building fabric performance will meet or exceed the Part L2A 2013 requirements where applicable. An energy assessment has been carried out based on design information to identify the most appropriate renewable strategy. The development will include roof mounted solar photovoltaics.

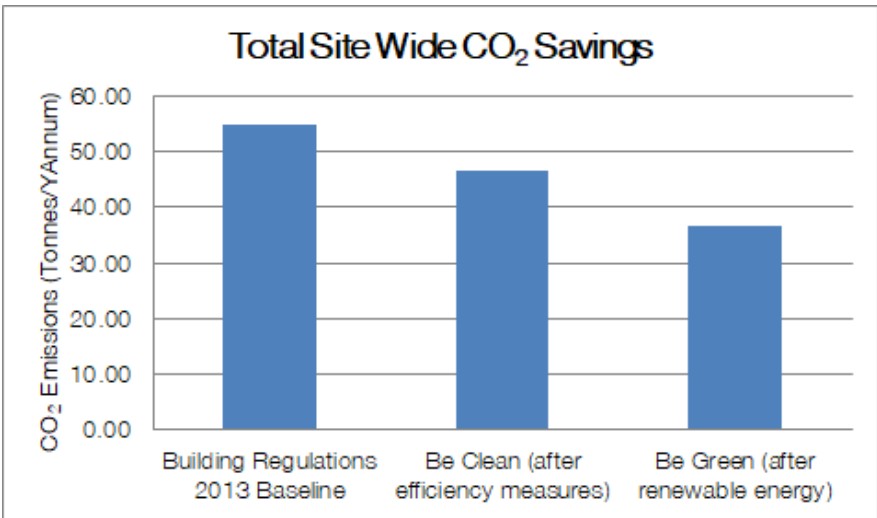


Figure 0.1: Summary of CO₂ savings for the interim strategy over Building Regulations 2013 baseline.

The proposed strategy has the potential to provide a 32.8 % improvement over the Building Regulations 2013 minimum target; through passive design measures, energy efficient equipment and renewable technologies.

Renewable technologies have been specified to achieve a 20.9 % reduction in site wide CO₂ emissions and generate 11.55 % of the total energy consumption of the development. This is in line with the target set out by the Reading Borough Council.

1 Introduction

1.1 Site Analysis

Price & Myers have been commissioned by Ball Hall Ltd. to produce an Energy Strategy Report for the proposed Sports Hall building of Leighton Park School in Reading. The scheme entails construction of a two-storey building measuring circa 2160sq.m. on a greenfield site. It will provide a large sports hall, fitness suite and associated changing facilities.



Figure 1.1: Satellite image with site boundary for Leighton Park Sports Hall

Our assessment has been based on drawings and details provided by CLAGUE Architects.

1.2 Objectives

This report summarises the work done to support the development of an energy strategy for the scheme. The strategy requires design, technical and commercial decisions in order to continue the design development and ultimately select the final solution for ensuring a low carbon development.

This report outlines the energy strategy for the development, including passive design, energy and CO2 footprint of the proposed scheme, and renewable energy options.

The final proposed strategy allows the scheme to demonstrate compliance with the guidelines set out by the Reading Borough Council in demonstrating a positive commitment to sustainability through providing environmental improvements.

2 Policy

2.1 National Planning Policy Framework

The framework replaces a wide range of previous planning policy statements and planning policy guidance as demonstrated below.

i. Planning Policy Statement 1 (PPS1) Delivering Sustainable Development

A recent consultation supplement to Planning Policy Statement 1: Planning and Climate Change sets out the Government's proposed further guidance, including: the expectation for development to gain a significant proportion from on-site renewables (10% is a standard requirement) a balance with their impact on landscape and townscape is of recognised importance

i. Planning Policy Statement 22 (PPS22) Renewable Energy

- Regional spatial strategies and local development documents should contain policies designed to promote and encourage, rather than restrict, the development of renewable energy resources
- The wider environmental and economic benefits of all proposals for renewable energy projects, whatever their scale, are material considerations that should be given significant weight in determining whether proposals should be granted planning permission
- Local planning authorities, regional stakeholders and Local Strategic Partnerships should foster community involvement in renewable energy projects

2.2 Reading Borough Council – Core Strategy Adopted Jan 2008, Altered Jan 2015

Policy CS1: Sustainable Construction and Design

Proposals for new development, including the construction of new buildings and the redevelopment and refurbishment of existing building stock, will be acceptable where the design of buildings and site layouts use energy, water, minerals, materials and other natural resources appropriately, efficiently and with care and take account of the effects of climate change. To meet these requirements: -

- All new housing is required to meet the most up to date Eco-Homes 'Very Good' as a minimum standard, and all new commercial developments are required to meet the most up to date BREEAM 'Very Good' as a minimum standard;
- On larger developments of more than 10 dwellings or 1,000 m² of floorspace, ensure that 50% of the provision meet the most up to date Eco-Homes and BREEAM 'Excellent' standards;
- All new developments maximise the use of energy efficiency and energy conservation measures in their design, layout and orientation to reduce overall energy demand;
- All developments of more than 10 dwellings or 1000m² floorspace incorporate on-site generation of energy from renewable sources and energy efficient design measures (including the use of CHP where appropriate) to off-set at least 20% of predicted carbon dioxide emissions from the estimated energy usage of the completed and occupied development.

3 Approach

The approach to achieving the planning policy energy objectives has been to consider strategies and technologies to achieve a low energy and carbon footprint for the scheme.

The development will adopt the following energy hierarchy:

- Use less energy through passive design measures (Be Lean);
- Supply and consume energy efficiently (Be Clean); and
- Utilise renewable energy sources to reduce carbon emissions (Be Green).

This energy strategy examines the energy performance of the proposed development based on the following methodology:

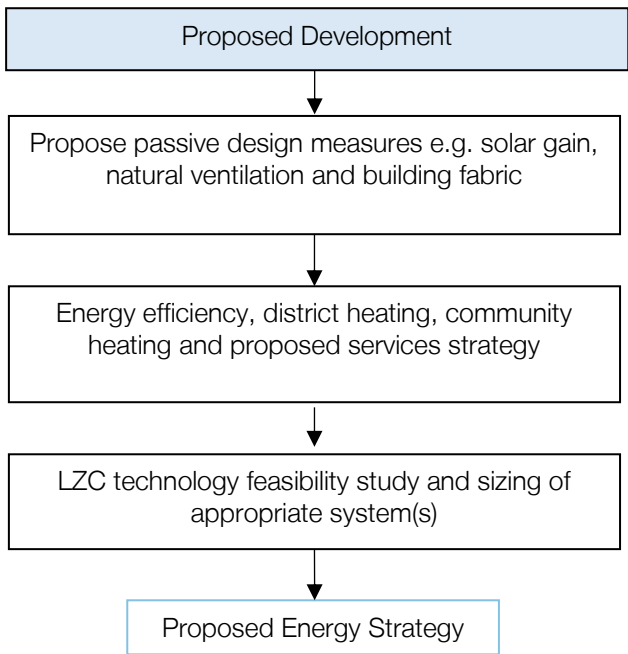


Figure 3.1 Methodology for Energy Performance Strategy.

The performance of the development in terms of energy consumption and carbon emissions is calculated at each stage of the assessment, ensuring that both regulated and unregulated energy is considered when determining the performance of the proposed energy strategy.

3.1 Accredited Energy Assessor

This report has been checked and reviewed by Deepika Singhal who is an accredited Low Carbon Energy Assessor. The energy consumption and carbon emission figures within this report have been calculated using the EDSL Tas Dynamic Simulation Modelling software.

4 Energy Targets

The target for the project is to achieve 20% reduction in carbon emissions through renewables in line with the Reading Council's planning policy. The development must also demonstrate an improvement over Part L2A of the building regulations. Table 4.1 details the energy broken down by fuel types and fuel use categories for the site. These values are the target energy and carbon calculations before any passive design and energy efficient measures.

Building Regulations Baseline Target Values: Regulated Energy Demand & CO ₂ Emissions															
	Gas				Electricity										
	Demand (kWh/yr)			CO ₂ (kg/yr)	Demand (kWh/yr)								CO ₂ (kg/yr)	Total Energy (kWh/yr)	Total CO ₂ (kg/yr)
Type	Space Heating	Hot Water	Total		Space Heating	Hot Water	Cooling	Pumps & Fans	Lighting	CHP Generation	PV Generation	Total			
Total	15,617	107,181	122,798	26,524	3,020	0	1,445	8,175	41,565	N/A	N/A	54,205	28,133	177,003	54,657

Table 4.1 Estimated regulated energy demand and carbon emissions per energy source

Sections 5,6 and 7 will show how the proposed passive design, energy efficiency measures and low and zero carbon technologies improve the design over these baseline figures.

The energy consumption calculations include regulated energy and unregulated energy fuel uses. Regulated energy is that used for space and water heating, lighting, pumps and fans. Energy consumption figures for these are calculated using dynamic thermal modelling for the site.

5 Passive Design (Be Lean)

As part of the Be Lean approach, passive design measures have been considered throughout the pre-planning stage to reduce energy demand.

5.1 Solar Gain Control and Daylighting

Where possible, windows and natural daylight have been provided to ensure appropriate daylighting levels throughout the development and reduce the lighting demand. The size and orientation of external windows has been considered carefully to balance daylight with excessive solar gains. Windows are specified to incorporate low emissivity coatings to limit overheating while ensuring adequate daylight. The glazing specifications used in the development are given in Table 5.1 below:

Glazing Parameters	U-value	G-value (Solar Transmittance)
Windows	1.2 W/m ² K	0.25
Kalwall Translucent Windows	1.15 W/m ² K	0.165

Table 5.1 Proposed glazing parameters for the commercial doors and windows

5.2 Overheating

Risks of excessive solar gain for the areas have been checked as part of the Part L analysis for the spaces and most areas comply with the minimum criteria. Blinds will need to be specified for south facing rooms to reduce gains.

5.3 Building Fabric Efficiency

To further improve the passive design of the development, the thermal fabric has been specified to meet or exceed current Building Regulations targets. Table 5.2 shows the proposed U-values that will be considered for the development and have been assumed for the energy strategy analysis at this stage.

Measure	Element	Commercial
U Values	External Brick Walls	0.15 W/m ² K
	Kingspan Longspan	0.14 W/m ² K
	Ground Floor	0.12 W/m ² K
	Metal Deck Insulated Roof	0.12 W/m ² K
	Internal wall	0.9 W/m ² K
	Sliding Glazed Door	1.32 W/m ² K (with frame)
	External Opaque Doors	1.08 W/m ² K (with frame)
Air Tightness		Pressure testing will be carried out to determine air tightness. This will be an assumed: 5 m ³ /m ² /h
Thermal Bridging		Default

Table 5.2 Proposed Be Lean passive design measure

6 Energy Efficient Equipment (Be Clean)

As part of the Be Clean approach, the use of heat networks, community heating and cooling and energy efficient equipment has been considered for this development.

6.1 District Energy Systems

District energy systems produce steam, hot water or chilled water at a central energy centre. The steam or water is distributed in pre-insulated pipework to individual buildings for space heating, domestic hot water and air conditioning. As a result, individual buildings served by a district energy system don't require their own boilers or chillers.

The Reading Borough Council portal shows that there is no network or possible network within close enough proximity of the site to consider connecting at this time. The development will provide the necessary infrastructure to connect in the future should a network be realised. This includes the provision of pipework to the site boundary to facilitate future connection.

6.2 Community Heating

Community heating involves distributing space and water heating services throughout the development served from a central plant, making use of higher efficiencies available from larger systems.

This is quite a large development, and at this scale, community heating is a viable solution. This provides a greater efficiency than individual systems. This solution also allows the opportunity to consider larger scale technologies and future proofs the development for potential connection to a district heating system.

6.3 Services Strategy

In addition to the passive design measures identified in Section 5, energy-efficient equipment has been proposed where possible to support the services strategy.

Table 6.1 shows the proposed services strategy and energy efficiency measures for the development.

Services	Meeting Room, Fitness Studio, Office	Sports Hall	WC / Shower Store / Changing
Space Heating	VRF with Heat Pump COP : 4.0	Gas Radiant Heaters 90% efficient	Condensing Gas Boiler 92% Efficient
Hot Water Heating	Condensing Gas Boiler 92% Efficient		
Heating Controls	Time and temperature zone control		
Comfort Cooling	VRF multi-split system COP : 4.2	No Cooling	
Ventilation	Mechanical Ventilation with heat recovery 85% Supply SFP: 0.7W/l/s Extract SFP: 0.4W/l/s	Mechanical Ventilation Supply SFP: 0.7W/l/s Extract SFP: 0.4W/l/s	Extract only SFP 0.3W/l/s
Lighting &Controls	Auto On/ Auto Off 95 lumens/circuit-watt		
	Manual daylight control		No daylight control
Electricity power factor	>0.95		
Light Metering with alarm for out of range values			

Table 6.1 Proposed energy efficient design measures

6.4 Carbon Savings

Based on the performance of the passive design and energy efficient measures proposed in Sections 5 and 6. Table 6.2 demonstrates the percentage improvement these have over the notional baseline levels. They are calculated using EDSL Tas Dynamic Simulation Modelling software. These figures are for performance before incorporating any on-site renewables.

	CO2 Emissions (T/yr)	CO2 Savings (T/yr)	% Saving
Building Regulations 2013 Baseline	54.66		
Passive Design & Energy Efficient Measures	46.44	8.22	15.0%

Table 6.2 Carbon savings at Be Clean Stage

The breakdown of energy use and carbon emissions have been calculated, as shown in Table 6.3.

Building Regulations Be Clean Values: Regulated Energy Demand & CO ₂ Emissions															
	Gas				CO ₂ (kg/yr)	Electricity							CO ₂ (kg/yr)	Total Energy (kWh/yr)	Total CO ₂ (kg/yr)
	Demand (kWh/yr)			Demand (kWh/yr)											
Type	Space Heating	Hot Water	Total	Space Heating		Hot Water	Cooling	Pumps & Fans	Lighting	CHP Generation	Total				
Total	18,809	105,995	124,804	26,958	3,645	0	841	5,393	27,653	NA	37,532	19,479	162,336	46,437	

Table 6.3 Estimated regulated energy demand and carbon emissions per energy source

7 Low and Zero Carbon Technologies Feasibility Study (Be Green)

The final level of the energy hierarchy is to Be Green, therefore the following table discusses the options for on-site low and zero carbon (LZC) technologies and their feasibility on this development to contribute to meeting the relevant London Plan and Borough's sustainability targets.

LZC Technologies	Description	Advantages	Disadvantages	Feasibility	
Solar Thermal Collectors	Solar thermal collectors can be used to provide hot water using the irradiation from the sun They can generally provide approx. 50% of the hot water demand	No noise issues associated with Solar thermal collectors No additional land use from the installation of solar thermal collectors Low maintenance and easy to manage Favourable payback periods	The hot water cylinder will need to be larger than a traditional cylinder Needs unobstructed space on roof Low efficiencies Often not compatible with other LZC technologies Saves less carbon when offsetting gas systems	There is a south east facing roof where solar thermal panels can be installed. However, solar PV is favoured due to greater potential carbon savings.	✗
Solar Photovoltaic Panels (PV)	Solar PV panels provide noiseless, low-maintenance, carbon free electricity	Can have significant impact on carbon emissions by offsetting grid electricity (which has a high carbon footprint) Low maintenance No noise issues No additional land use from the installation of PV panels Bolt on technology that does not need significant amounts of auxiliary equipment Favourable payback periods	Needs unobstructed space on roof Low efficiencies per unit area of PV Often used to supplement landlord's electricity so savings not always transferred to individual properties	There is a large roof space on which Solar PV panels could be installed to contribute to the electricity demand of the building	✓

LZC Technologies	Description	Advantages	Disadvantages	Feasibility	
CHP (Combined Heat & Power)	CHP systems use an engine driven alternator to generate electricity while using the waste heat from the engine, jacket and exhaust to provide heating and hot water Economic viability relies on at least 4,000 hours running time per annum	Mature technology High CO ₂ savings	Cost of the system is relatively high for small schemes Only appropriate for large development with high heat loads	Communal CHP is not viable this development due to inconsistent energy demand. Micro CHP would be technically feasible but is unlikely to save enough carbon to meet the targets with incorporating multiple technologies	✗
Biomass Heating	Solid, liquid or gaseous fuels derived from plant material can provide boiler heat for space and water heating	Potential to reduce large component of the total CO ₂ A biomass boiler would supplement a standard gas heating system so some of the cost may be offset through money saved on using smaller traditional boilers	Regular maintenance is required Reliability of fuel access/supply can be a problem The noise generated by a biomass boiler is similar to that of a gas boiler. It is advisable not to locate next to particularly sensitive areas such as bedrooms A plant room and fuel store will be required which may take additional land from the proposed development or surroundings Biomass is often not a favoured technology in new development due to the potential local impacts of NOx emissions and delivery vehicles for the fuel	Biomass is not considered feasible for this development due to issues with fuel storage, access for delivery vehicles and local NOx emissions	✗

LZC Technologies	Description	Advantages	Disadvantages	Feasibility	
Wind Turbines	Vertical and horizontal axis wind turbines enable electricity to be generated using the power within the wind	Low noise Bolt on technology that does not need significant amounts of auxiliary equipment	Not suitable for urban environments due to low wind conditions and obstructions High visual impact Noise impact (45-65dB at 3m) High capital cost and only achieve good paybacks in locations with strong wind profiles Requires foundations or vibration supports for building installations (generally not recommended)	This development is in a semi-urban environment and so a wind turbine will not generate much energy	✘
Ground Source Heat Pumps (GSHP)	Utilising horizontal loops or vertical boreholes, GSHP make use of the grounds almost constant temperature to provide heating and/or cooling using a heat exchanger connected to a space/water heating delivery system	Low maintenance and easy to manage High COP (ratio of energy output per energy input) Optimum efficiency with underfloor heating systems As heat pumps would replace standard heating systems, some of the cost may offset through savings on a traditional boiler	The heat pump has a noise level around 35-60dB so some attenuation may be required and it should be sensibly located Relatively high capital cost Requires electricity to run the pump, therefore limited carbon savings in some cases For communal systems a plant room is required which may take additional land from the proposed development/surroundings	There is external space available for installation of boreholes and pipework. However, GSHP is not a feasible technology for this development as the energy demand is considerably low to justify the cost of installation and maintenance.	✘

LZC Technologies	Description	Advantages	Disadvantages	Feasibility
Air Source Heat Pumps (ASHP)	Air Source Heat Pumps extract latent energy from the external air in a manner similar to ground source heat pumps	ASHP systems are generally cheaper than GSHP as there is no requirement for long lengths of buried piping or boreholes Low maintenance and easy to manage Optimum efficiency with underfloor heating systems As heat pumps would replace standard heating systems, some of the cost may offset through savings on a traditional boiler	The ASHP unit has a noise level around 50-60dB so some attenuation may be required and it should be sensibly located The potential noise from the external unit may mean there is local opposition to their installation Requires electricity to run the pump, therefore limited carbon savings in some cases For communal systems a plant room is required which may take additional land from the proposed development/surroundings	The use of ASHP is technically feasible for the development but is discounted due to noise issues and locating the unsightly units. ✘

Table 7.1: Feasibility of LZC technologies for the development

Having reviewed potential LZC technologies for the development it has been identified that the most appropriate system would be solar PV panels, which would most suitably be installed on the roof space. The chosen system should be accurately sized during the detailed design stages and MCS (Microgeneration Certification Scheme) approved equipment and installers used.

7.1 Summary of CO₂ Emission Savings

The most appropriate LZC technology for the development has been identified as solar PV panels in order to meet the Reading Borough Council's target of 20% for on-site renewables.

Table 7.2 shows the proposed system size and the estimated energy and carbon emissions savings and financial feasibility for this development. The breakdown of energy use and carbon emissions for the final case have been calculated, as shown in Table 7.3.

Proposed LZC Technologies	Energy & CO ₂			
	Energy generated (kWh/yr)	% site energy demand met	CO ₂ saved by system (kgCO ₂ /yr)	% reduction in site CO ₂ emissions
Total Solar PV = 31.25 KWp No Of Panels = 96 (South East facing, Horizontal, Roof mounted)	18,744	11.55%	9,728	20.9%

Table 7.2 Energy, carbon and financial performance of the proposed LZC technologies

Be Green Case: Regulated Energy Demand & CO2 Emissions															
	Gas				Electricity										
	Demand (kWh/yr)			CO2 (kg/yr)	Demand (kWh/yr)								CO2 (kg/yr)	Total Energy (kWh/yr)	Total CO2 (kg/yr)
Type	Space Heating	Hot Water	Total		Space Heating	Hot Water	Cooling	Pumps & Fans	Lighting	CHP Generation	PV Generation	Total			
Total	18,809	105,995	124,804	26,958	3,645	0	841	5,393	27,653	0	-18,744	18,787	9,751	143,591	36,708

Table 7.3 Estimated regulated energy demand and carbon emissions per energy source

7.2 Carbon Savings

Table 7.4 demonstrates the percentage improvement over the notional baseline levels for the development incorporating all three stages of the energy hierarchy.

	CO2 Emissions (T/yr)	CO2 Savings (T/yr)	% Saving
Building Regulations 2013 Baseline	54.66		
Passive Design & Energy Efficient Equipment	46.44	8.22	15.0%
After LZCs	36.71	9.73	17.8%
Total Cumulative Savings		17.95	32.8%

Table 7.4 Carbon savings at the be Green stage

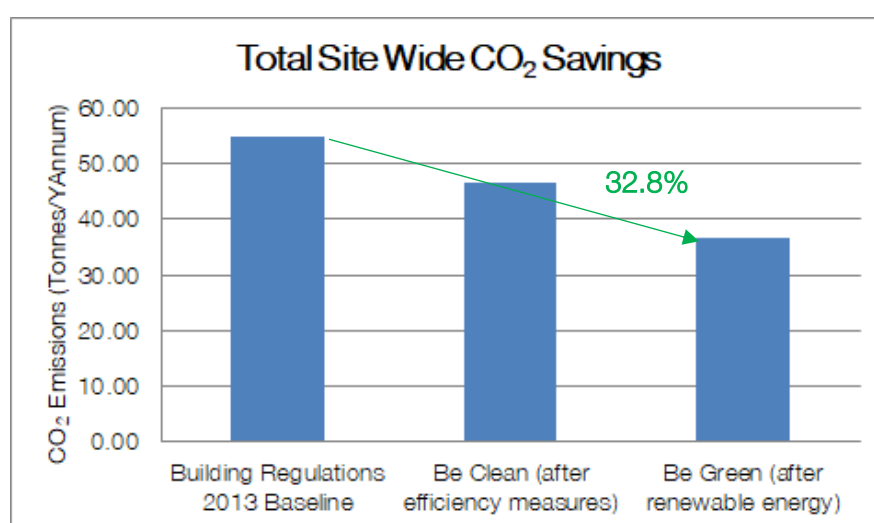


Figure 7.1: Summary of CO2 savings (tonnes CO2/annum) over Building Regulations 2013 baseline

The development has followed the energy hierarchy and all feasible measures to achieve an improvement of 32.8% over building regulations.

Renewable technologies have been specified to achieve a 20.9 % reduction in site wide CO2 emissions and generate 11.55 % of the total energy consumption of the development. This is in line with the targets set out by the Reading Borough Council.

8 Conclusion

Following the energy hierarchy, passive design measures, energy efficient equipment and provision of LZCs have shown an improvement of 32.8% over the Building Regulations Part L 2013 target emissions rate for the development.

The design team have made all reasonable endeavours to achieve the minimum requirements of the Reading Borough Council requirement. The energy hierarchy has been followed, fabric improvements have been made and a high efficiency heating has been specified. PV panels have been incorporated into the design to reduce carbon emissions from the site.

Renewable technologies have been specified to achieve a 20.9 % reduction in site wide CO₂ emissions and generate 11.55 % of the total energy consumption of the development. This is in line with the targets set out by the Reading Borough Council.

The figures within this report are based on preliminary analysis only and further detailed studies will be required at the detailed design stage before specifying any of the proposed systems.

Appendix A

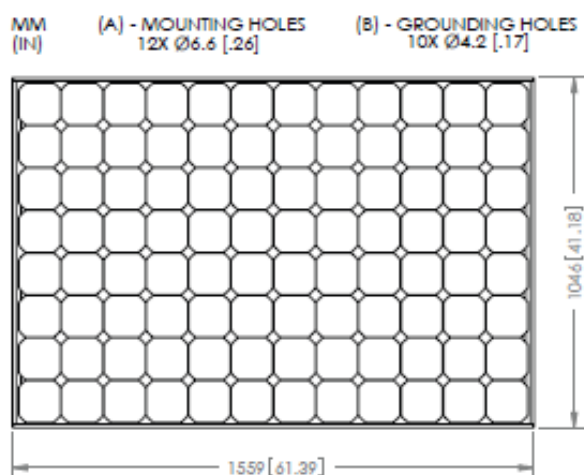
Figures used in Calculations

1 Figures used in Low and Zero Carbon Technology Calculations

The following tables show figures used in the energy and CO₂ calculations to estimate energy produced and CO₂ savings from LZC technologies. These figures can be used to validate the results.

CO ₂ Intensity Values	
Gas Intensity	0.216 kgCO ₂ /kWh
Electricity Intensity	0.519 kgCO ₂ /kWh
Oil Intensity	0.266 kgCO ₂ /kWh
Biodiesel Intensity	0.025 kgCO ₂ /kWh

2 PV calculation



PV specification	
PV panel size	1.046 x 1.56
PV panel area per panel (m ²)	1.63
PV panel rated output (kWp)	0.327 kWp
Efficiency of solar thermal collectors	0.20 kWp/m ²

Appendix B

BRUKL Report

Project name

Leighton Park Sport's Hall-Be Green

As designed

Date: Fri Jul 27 14:23:13 2018

Administrative information

Building Details

Address: Reading,

Certification tool

Calculation engine: TAS

Calculation engine version: "v9.4.1"

Interface to calculation engine: TAS

Interface to calculation engine version: v9.4.1

BRUKL compliance check version: v5.2.g.3

Owner Details

Name:

Telephone number:

Address: , ,

Certifier details

Name:

Telephone number:

Address: , ,

Criterion 1: The calculated CO₂ emission rate for the building should not exceed the target

CO ₂ emission rate from the notional building, kgCO ₂ /m ² .annum	24.7
Target CO ₂ emission rate (TER), kgCO ₂ /m ² .annum	24.7
Building CO ₂ emission rate (BER), kgCO ₂ /m ² .annum	16.3
Are emissions from the building less than or equal to the target?	BER =< TER
Are as built details the same as used in the BER calculations?	Separate submission

Criterion 2: The performance of the building fabric and the building services should achieve reasonable overall standards of energy efficiency

Values not achieving standards in the Non-Domestic Building Services Compliance Guide and Part L are displayed in red.

Building fabric

Element	U _a -Limit	U _a -Calc	U _i -Calc	Surface where the maximum value occurs*
Wall**	0.35	0.15	0.15	External Wall
Floor	0.25	0.12	0.12	Ground Floor
Roof	0.25	0.12	0.12	Roof
Windows***, roof windows, and rooflights	2.2	1.16	1.17	Lower Window G
Personnel doors	2.2	1.1	1.1	Main Door
Vehicle access & similar large doors	1.5	-	-	No vehicle doors in project
High usage entrance doors	3.5	1.3	1.3	Sliding Door

U_a-Limit = Limiting area-weighted average U-values [W/(m²K)]U_a-Calc = Calculated area-weighted average U-values [W/(m²K)]U_i-Calc = Calculated maximum individual element U-values [W/(m²K)]

* There might be more than one surface where the maximum U-value occurs.

** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.

*** Display windows and similar glazing are excluded from the U-value check.

N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air Permeability	Worst acceptable standard	This building
m ³ /(h.m ²) at 50 Pa	10	5

Building services

The standard values listed below are minimum values for efficiencies and maximum values for SFPs. Refer to the Non-Domestic Building Services Compliance Guide for details.

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	YES
Whole building electric power factor achieved by power factor correction	>0.95

1- Sports Courts (4 Zones)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.9	-	-	1.1	-
Standard value	0.86	N/A	N/A	1.5 [^]	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES
[^] Allowed SFP may be increased by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide.					

2- Extract only (14 Zones)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.92	-	-	-	-
Standard value	0.91 [*]	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES
[*] Standard shown is for gas single boiler systems ≤2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.					

3- Underfloor Heating (8 Zones)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.92	-	-	1.1	-
Standard value	0.91 [*]	N/A	N/A	1.1 [^]	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES
[*] Standard shown is for gas single boiler systems ≤2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.					
[^] Allowed SFP may be increased by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide.					

4- Comfort Cooling (6 Zones)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	4	4.2	-	1.1	0.85
Standard value	2.5 [*]	2.6	N/A	1.6 [^]	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES
[*] Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps. For types ≤12 kW output, refer to EN 14825 for limiting standards.					
[^] Allowed SFP may be increased by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide.					

1- New HWS Circuit

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	0.92	0
Standard value	0.9 [*]	N/A
[*] Standard shown is for gas boilers >30 kW output. For boilers ≤30 kW output, limiting efficiency is 0.73.		

"No zones in project where local mechanical ventilation, exhaust, or terminal unit is applicable"

General lighting and display lighting		Luminous efficacy [lm/W]			General lighting [W]
Zone name		Luminaire	Lamp	Display lamp	
	Standard value	60	60	22	
GF Courts		-	95	-	1236

General lighting and display lighting		Luminous efficacy [lm/W]			General lighting [W]
Zone name		Luminaire	Lamp	Display lamp	
	Standard value	60	60	22	
GF SS1		95	-	-	40
GF MS		95	-	-	15
GF BR		-	95	-	189
GF Stairs		-	95	-	31
GF K		-	95	-	108
GF F1		95	-	-	235
GF D1		-	95	-	25
GF D2		-	95	-	33
GF T1		-	95	-	90
GF T2		-	95	-	89
GF C1		-	95	-	46
GF C2		-	95	-	47
GF P		95	-	-	66
GF C3		-	95	-	64
GF CL		95	-	-	6
GF C4		-	95	-	62
GF Corridor		-	95	-	150
GF Toi1		-	95	-	25
GF Toi2		-	95	-	25
GF Shower1		-	95	-	52
GF Shower2		-	95	-	53
GF Ent Lobby		-	95	22	260
GF Back Lobby		-	95	22	56
GF FA		95	-	-	75
FF Gallery		-	95	22	187
FF D3		-	95	-	33
FF S2		95	-	-	17
FF M1		95	-	-	394
FF M2		95	-	-	395
FF M3		95	-	-	395
FF Fit Suite		-	95	-	468
FF Corridor		-	95	-	102
FF S3		95	-	-	14
FF S4		95	-	-	15
FF Fit Suite2		-	95	-	351
GF Courts2		-	95	-	1421
GF Courts3		-	95	-	1334
GF Courts4		-	95	-	1265
GF SS		95	-	-	54

Criterion 3: The spaces in the building should have appropriate passive control measures to limit solar gains

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
GF Courts	NO (-89%)	NO
GF BR	NO (-90%)	NO
GF F1	NO (-82%)	NO
GF Ent Lobby	NO (-25%)	NO
GF Back Lobby	NO (-48%)	NO
GF FA	N/A	N/A
FF Gallery	NO (-99%)	NO
FF M1	NO (-52%)	NO
FF M2	NO (-53%)	NO
FF M3	NO (-52%)	NO
FF Fit Suite	NO (-51%)	NO
FF Fit Suite2	NO (-81%)	NO
GF Courts2	NO (-97%)	NO
GF Courts3	NO (-99%)	NO
GF Courts4	N/A	N/A

Criterion 4: The performance of the building, as built, should be consistent with the calculated BER

Separate submission

Criterion 5: The necessary provisions for enabling energy-efficient operation of the building should be in place

Separate submission

EPBD (Recast): Consideration of alternative energy systems

Were alternative energy systems considered and analysed as part of the design process?	NO
Is evidence of such assessment available as a separate submission?	NO
Are any such measures included in the proposed design?	NO

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m ²]	2157	2157
External area [m ²]	5106	5106
Weather	LON	LON
Infiltration [m ³ /hm ² @ 50Pa]	5	5
Average conductance [W/K]	1144	1326
Average U-value [W/m ² K]	0.22	0.26
Alpha value* [%]	15.15	15.15

* Percentage of the building's average heat transfer coefficient which is due to thermal bridging

Building Use

% Area Building Type

A1/A2 Retail/Financial and Professional services
A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways
B1 Offices and Workshop businesses
B2 to B7 General Industrial and Special Industrial Groups
B8 Storage or Distribution
C1 Hotels
C2 Residential Inst.: Hospitals and Care Homes
C2 Residential Inst.: Residential schools
C2 Residential Inst.: Universities and colleges
C2A Secure Residential Inst.
Residential spaces
D1 Non-residential Inst.: Community/Day Centre
D1 Non-residential Inst.: Libraries, Museums, and Galleries
100 D1 Non-residential Inst.: Education
D1 Non-residential Inst.: Primary Health Care Building
D1 Non-residential Inst.: Crown and County Courts
D2 General Assembly and Leisure, Night Clubs and Theatres
Others: Passenger terminals
Others: Emergency services
Others: Miscellaneous 24hr activities
Others: Car Parks 24 hrs
Others - Stand alone utility block

Energy Consumption by End Use [kWh/m²]

	Actual	Notional
Heating	10.41	8.64
Cooling	0.39	0.67
Auxiliary	2.5	3.79
Lighting	12.82	19.27
Hot water	49.14	49.69
Equipment*	12.57	12.57
TOTAL**	75.26	82.05

* Energy used by equipment does not count towards the total for calculating emissions.

** Total is net of any electrical energy displaced by CHP generators, if applicable.

Energy Production by Technology [kWh/m²]

	Actual	Notional
Photovoltaic systems	8.69	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0

Energy & CO₂ Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m ²]	40.03	36.79
Primary energy* [kWh/m ²]	119.86	142.07
Total emissions [kg/m ²]	16.3	24.7

* Primary energy is net of any electrical energy displaced by CHP generators, if applicable.

HVAC Systems Performance										
System Type	Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEFF	Cool SSEER	Heat gen SEFF	Cool gen SEER	
[ST] Unflued radiant heater, [HS] Radiant heater, [HFT] Natural Gas, [CFT] Electricity										
Actual	43.3	0	14.9	0	2.5	0.81	0	0.9	0	
Notional	32.8	0	10.6	0	4.8	0.86	0	----	----	
[ST] Central heating using water: floor heating, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
Actual	61.7	0	19.6	0	3	0.87	0	0.92	0	
Notional	61.4	0	20.8	0	3.6	0.82	0	----	----	
[ST] Central heating using water: floor heating, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
Actual	27.9	0	8.9	0	4.6	0.87	0	0.92	0	
Notional	16.1	0	5.4	0	5.4	0.83	0	----	----	
[ST] Central heating using water: floor heating, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity										
Actual	9.4	37.8	0.7	2.5	4.6	4	4.2	4	4.2	
Notional	14.3	56.3	4.9	4.3	3.2	0.82	3.6	----	----	

Key to terms

Heat dem [MJ/m2]	= Heating energy demand
Cool dem [MJ/m2]	= Cooling energy demand
Heat con [kWh/m2]	= Heating energy consumption
Cool con [kWh/m2]	= Cooling energy consumption
Aux con [kWh/m2]	= Auxiliary energy consumption
Heat SSEFF	= Heating system seasonal efficiency (for notional building, value depends on activity glazing class)
Cool SSEER	= Cooling system seasonal energy efficiency ratio
Heat gen SSEFF	= Heating generator seasonal efficiency
Cool gen SSEER	= Cooling generator seasonal energy efficiency ratio
ST	= System type
HS	= Heat source
HFT	= Heating fuel type
CFT	= Cooling fuel type

Key Features

The BCO can give particular attention to items with specifications that are better than typically expected.

Building fabric

Element	U _{i-Typ}	U _{i-Min}	Surface where the minimum value occurs*
Wall	0.23	0.15	External Wall
Floor	0.2	0.12	Ground Floor
Roof	0.15	0.12	Roof
Windows, roof windows, and rooflights	1.5	1.16	Trans Window
Personnel doors	1.5	1.1	Main Door
Vehicle access & similar large doors	1.5	-	No vehicle doors in project
High usage entrance doors	1.5	1.3	Sliding Door
U _{i-Typ} = Typical individual element U-values [W/(m²K)] U _{i-Min} = Minimum individual element U-values [W/(m²K)] * There might be more than one surface where the minimum U-value occurs.			

Air Permeability	Typical value	This building
m³/(h.m²) at 50 Pa	5	5